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exemplary encoding example of FIG. 9, and the exemplary values in Table II of encoding parameters 30, assume that a hexadecimal data value 140 of "12345678" is to be encoded into a set of data regions 80. Each data region 80 is to have the minimum detectable size of 30 pixels in the horizontal X direction, and 30 pixels in the vertical Y direction.

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Parameter	Exemplary Value
NumChannels	3
MinX	30 pixels
MinY	30 pixels
MinColorVal	10
MaxColorVal	255
MinColorChg	7

**Table II**

The number of discrete colors in the color choice set is  $(255-10)/7 = 32.8$ , which is truncated to 32. The number of bits of binary data that can be represented in a region 80 by 32 discrete colors is calculated  $\log_2 32$ , which (after truncation) is 5 bits. Therefore, the binary representation 142 of the hex data 140 is treated as a stream of data and segmented into six 5-bit blocks 144, each 5-bit block for encoding into a data region 80. (In this example, the two leftover bits 146 of the binary data 142 would be encoded as part of a further region which is not shown.)

The data value of each 5-bit block 144 is then converted into a corresponding one of a set of color channel values 148, according to the formula:

$$\text{Color Channel Value} = (\text{Data Value} * \text{MinColorChg}) + \text{MinColorVal}$$

Since NumChannels in this example is 3, representing an RGB color encoding scheme, three color channel values are grouped together to define the color of each region 80. Region 80a has an RGB color value of (24,66,192), and region 80b has an RGB color value of (45,94,220).

The decoding of a received data section 6b produced by transmitting the exemplary regions 80a,80b through the image data channel 40 to form corresponding received colored data marking regions 150a,150b will now be considered in further detail. For purposes of illustration, assume that the image distortion characteristics 32 of the image data channel 40 transformed the regions 80a,80b by scaling them such that each region now occupies 35 pixels in the X direction and 25 pixels in the Y direction. In addition, assume that the effect of other transformations such as color mapping, downsampling, smoothing, and compression resulted in each received region 150a,150b having a number of subregions of different colors. As discussed heretofore, the transformations performed by the image data channel 40 are determined through analysis of the transformations made to the known tuning pattern 86 during transmission over the channel 40.

To determine the recovered color channel value of each of a set of recovered color channel values 152 represented by the regions 150a,150b, in the preferred embodiment the RGB color values of each pixel within the individual region 150a,150b are averaged together. Alternate embodiments may use different algorithms known in the art to

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calculate the recovered color channel values. The averaging results in an averaged RGB color value of (22,68,189) for exemplary region 150a, and an averaged RGB color value of (43,96,217) for exemplary region 150b.

The recovered channel values 152 are converted into corresponding 5-bit blocks of recovered binary data 154 according to the formula (with the result rounded to the nearest integer):

$$\text{Block Value} = (\text{Recovered Channel Value} - \text{MinColorVal}) / \text{MinColorChg}$$

Another embodiment of the present invention, as best understood with reference to FIG. 10, is a method 200 of encoding binary data 2 for transmission over an image data channel 40. At 202, binary data 2 to be encoded into a linear matrix image 4 for transmission over an image data channel 40 is provided. At 204, in some embodiments, redundant information is added to the binary data 2. The purpose of the redundant information is to allow error correction and detection to be performed on the received data section 6b after transmission over the image data channel 40, and the redundant information is provided according to a conventional error correction and detection algorithm. At 206, in some embodiments, the binary data is encrypted for security purposes according to a conventional encryption algorithm. At 208, encoding parameters for encoding the binary data 2 (after any addition 204 of redundant data and/or encryption 206) are defined such that a transformed matrix image 6 produced by the